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Lee et al.

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(54) **MOBILE TERMINAL**

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H04M 1/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 1/1652*** (2013.01); ***G06F 1/1616*** (2013.01); ***H04M 1/0216*** (2013.01); ***H04M 1/0268*** (2013.01)

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USPC 361/79.01, 679.02, 679.04–679.09, 361/679.26–679.3, 679.55, 679.59; 455/575.1–575.9; 345/156, 157, 168, 345/169
See application file for complete search history.

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(57) **ABSTRACT**

A mobile terminal includes a flexible display unit configured to be deformed from a first state as an unfolded state to a second state as a folded state or from the second state to the first state, a first body unit configured to support one region of the display unit, a second body unit rotatably connected to the first body unit, configured to support the other remaining region of the display unit, and configured to become away from the first body unit while the flexible display unit is being changed from the second state to the first state, and a hinge unit configured to rotatably connect the first and second body units.

18 Claims, 13 Drawing Sheets

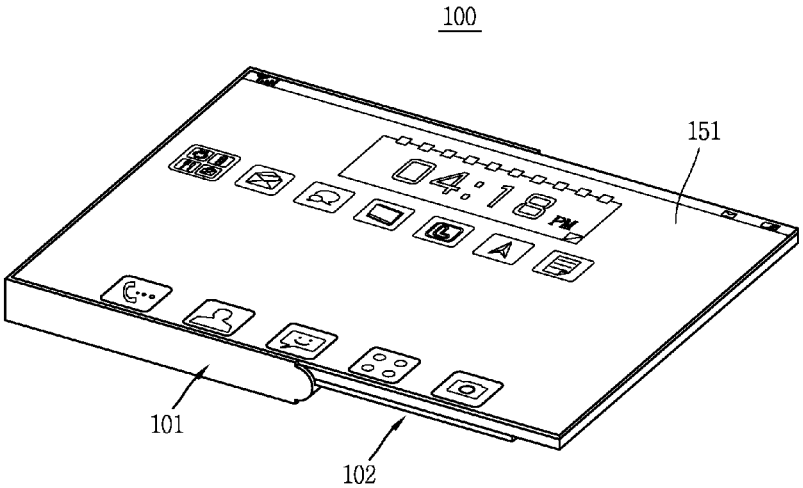

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FIG. 1

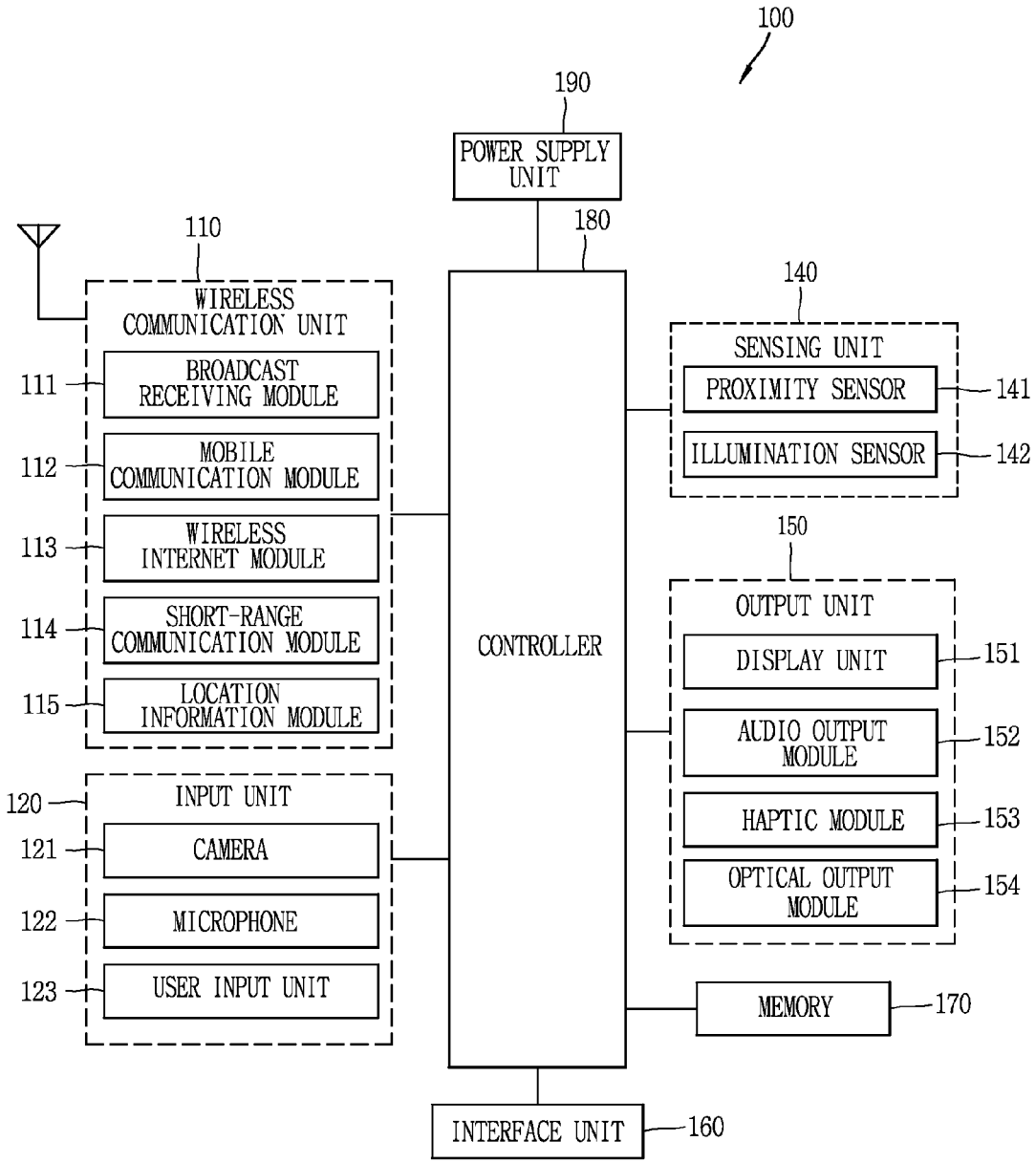

100
190
POWER SUPPLY UNIT
180
110
WIRELESS COMMUNICATION UNIT
111
BROADCAST RECEIVING MODULE
112
MOBILE COMMUNICATION MODULE
113
WIRELESS INTERNET MODULE
114
SHORT-RANGE COMMUNICATION MODULE
115
LOCATION INFORMATION MODULE
120
INPUT UNIT
121
CAMERA
122
MICROPHONE
123
USER INPUT UNIT
CONTROLLER
140
SENSING UNIT
PROXIMITY SENSOR
141
ILLUMINATION SENSOR
142
150
OUTPUT UNIT
DISPLAY UNIT
151
AUDIO OUTPUT MODULE
152
HAPTIC MODULE
153
OPTICAL OUTPUT MODULE
154
MEMORY
170
INTERFACE UNIT
160

FIG. 1B(a)

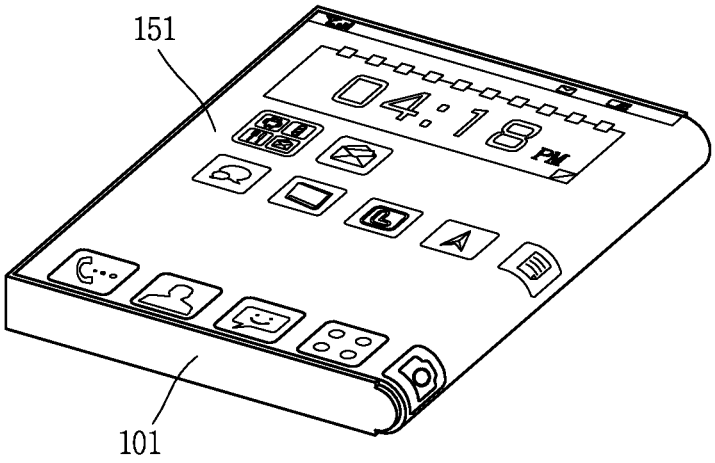


FIG. 1B(b)

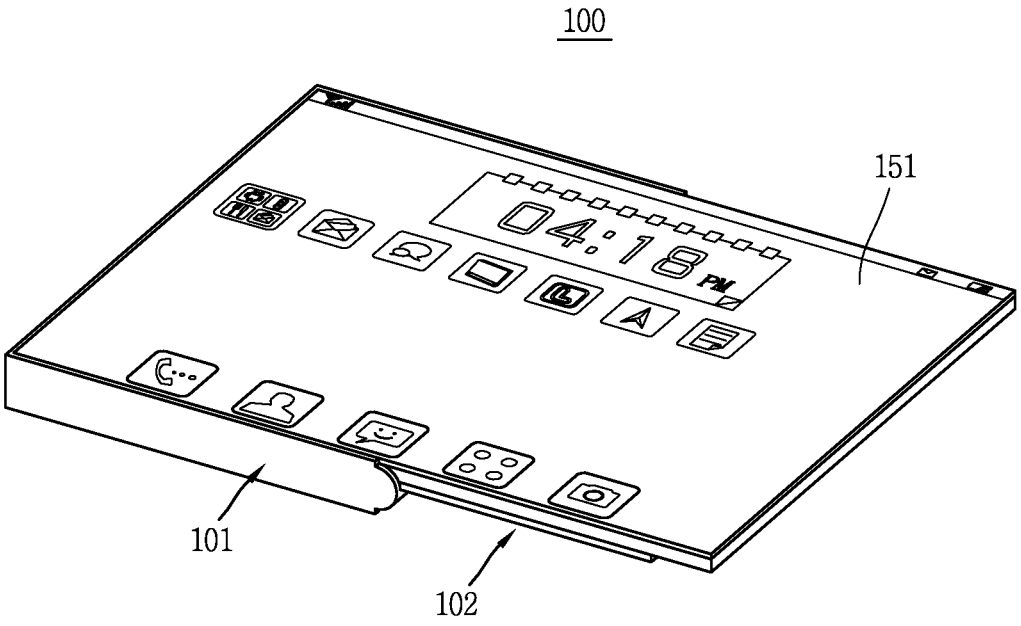


FIG. 2A

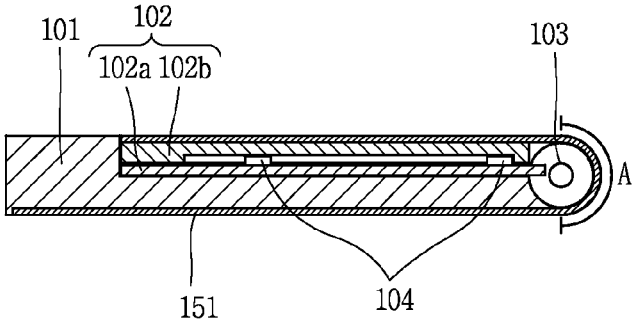

101
102
102a 102b
103
A
151
104

FIG. 2B

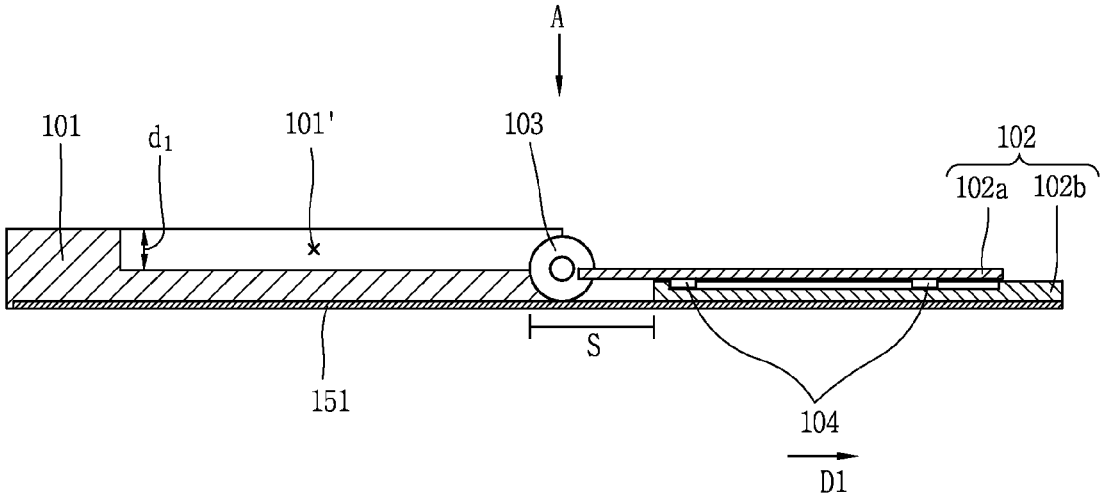

A
101
d_1
101'
103
102
102a
102b
S
151
104
D1

FIG. 2C

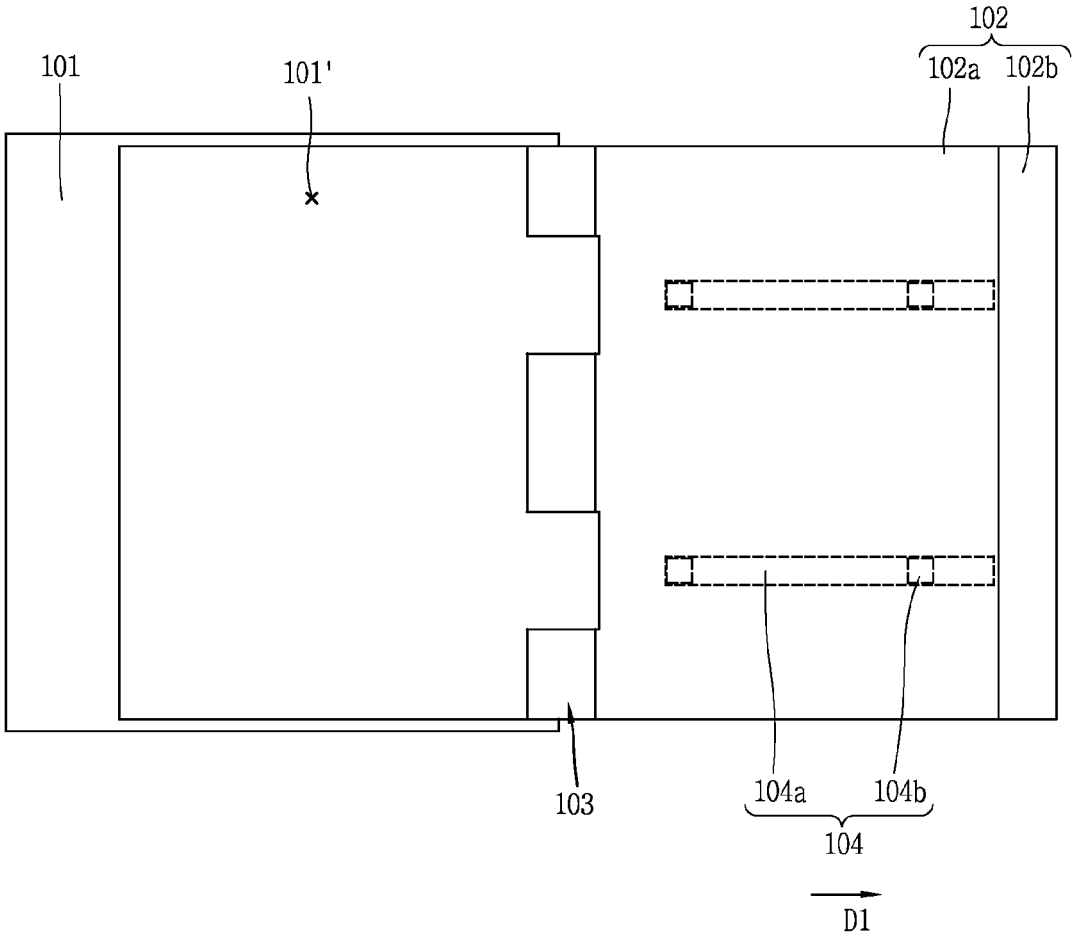


FIG. 2D(a)

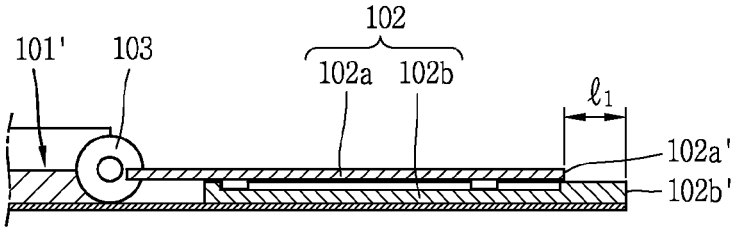


FIG. 2D(b)

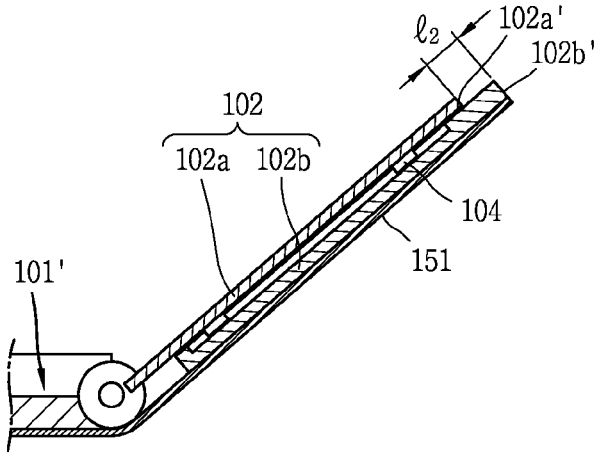


FIG. 2D(c)

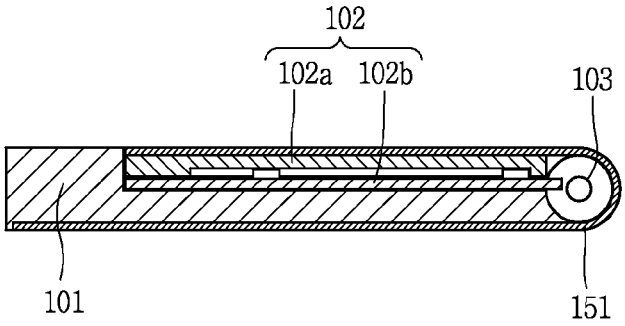


FIG. 3A

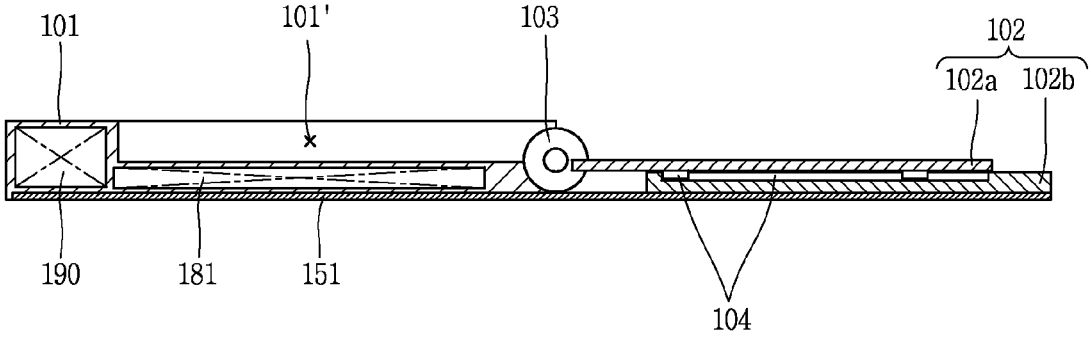


FIG. 3B(a)

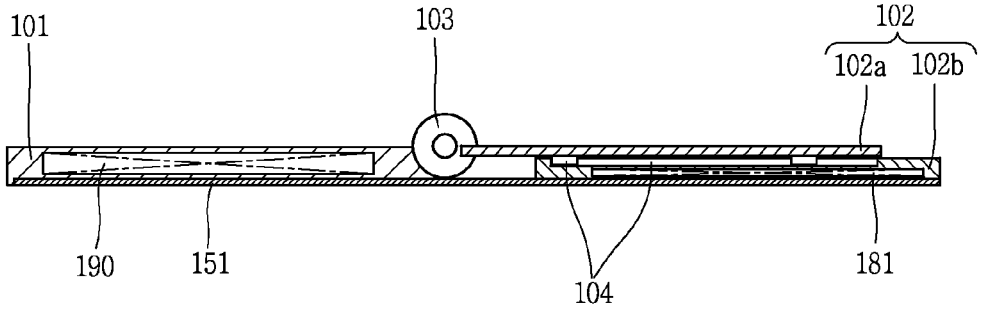


FIG. 3B(b)

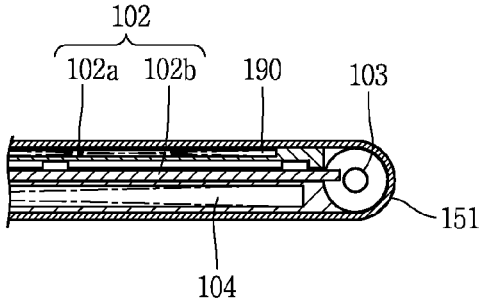


FIG. 4A(a)

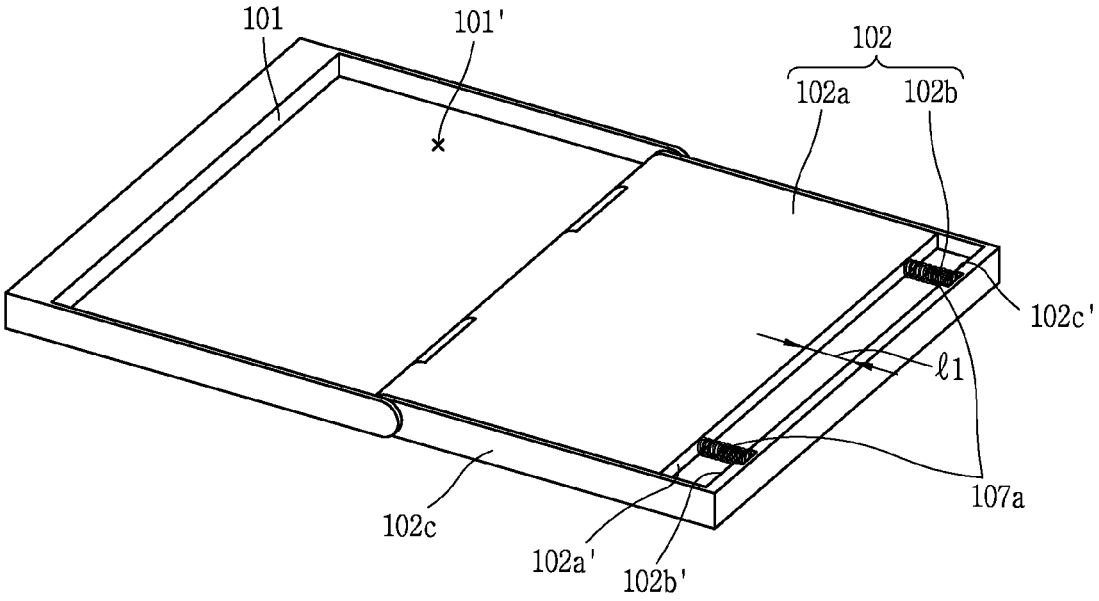


FIG. 4A(b)

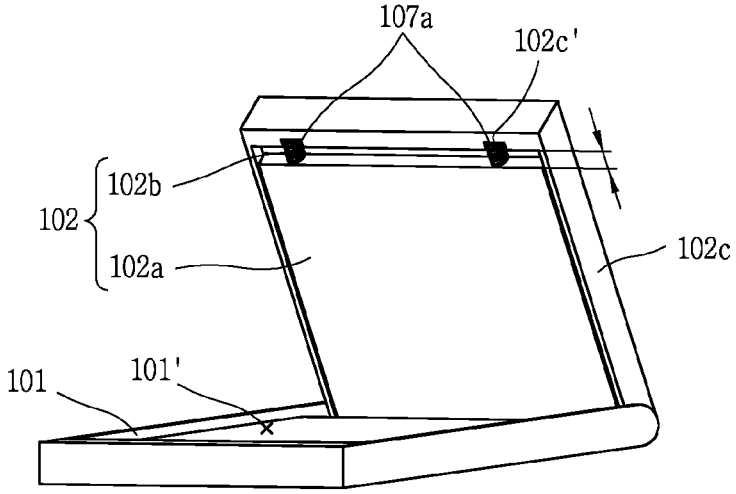


FIG. 4B

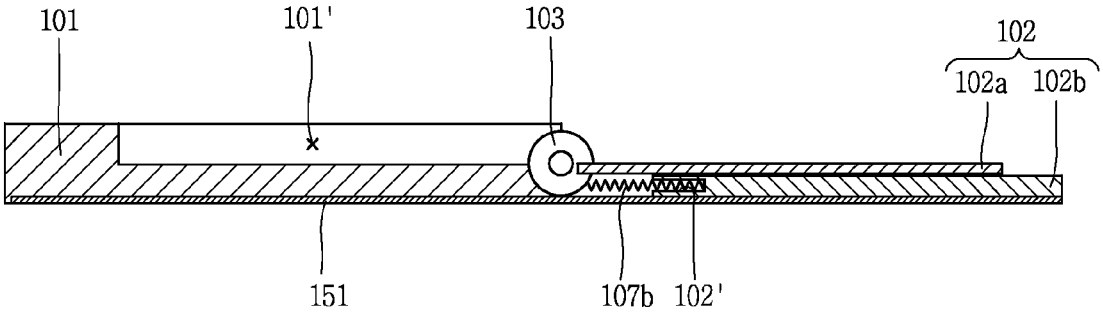
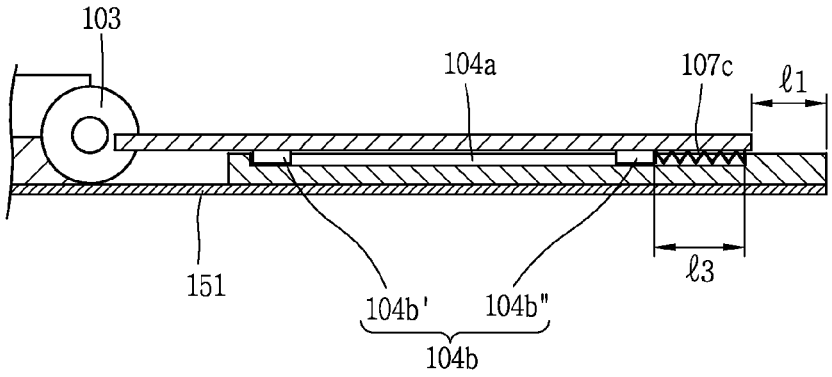

101
101'
103
102
102a
102b
151
107b
102'

FIG. 4C


103
104a
107c
ℓ1
151
104b'
104b"
104b
ℓ3

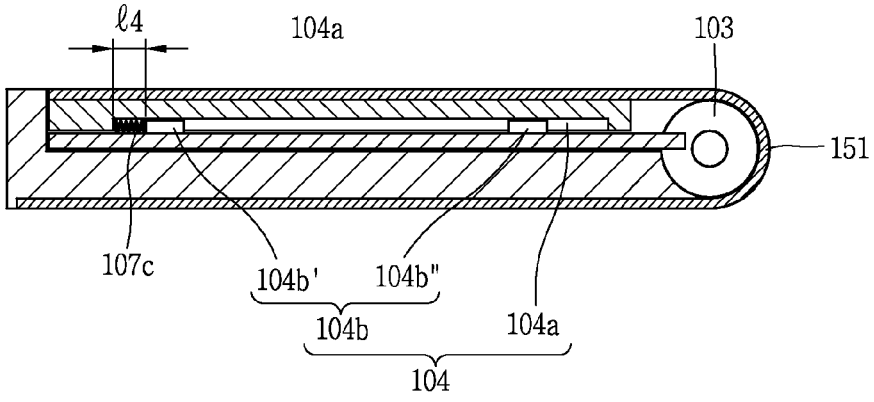

ℓ4
104a
103
151
107c
104b'
104b"
104b
104a
104

FIG. 4D

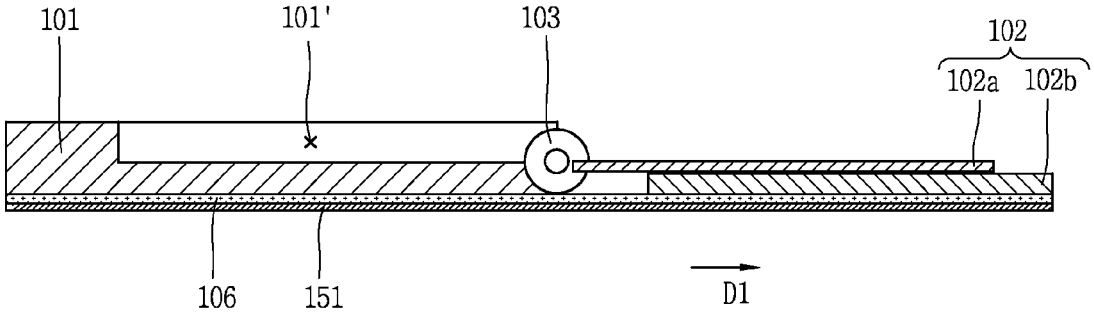


FIG. 5A

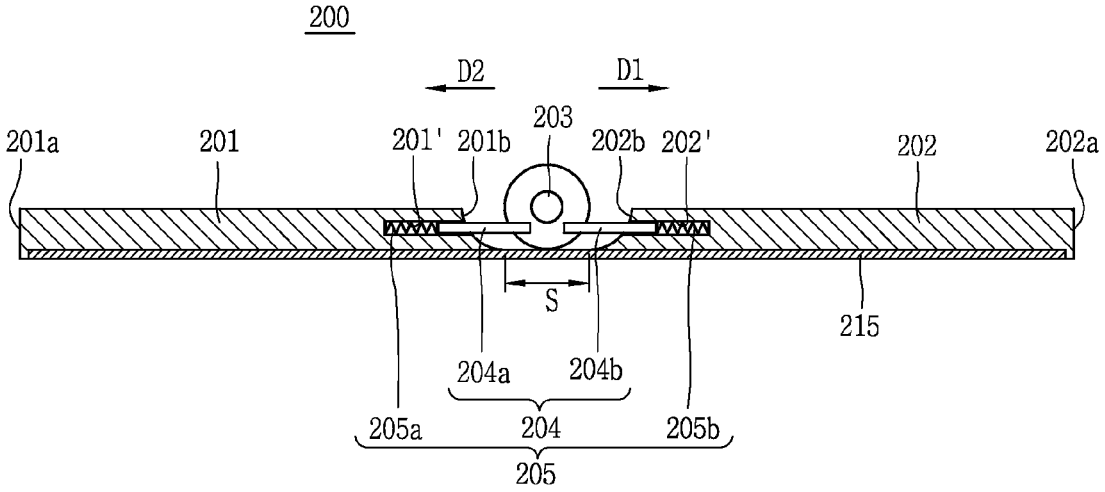

200
D2
D1
203
201a
201
201'
201b
202b
202'
202
202a
S
215
204a
204b
205a
204
205b
205

FIG. 5B

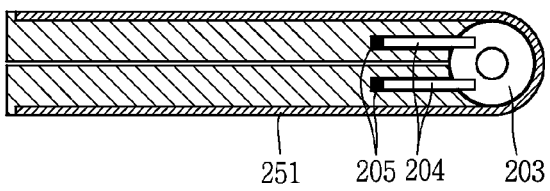

251
205
204
203

FIG. 6A

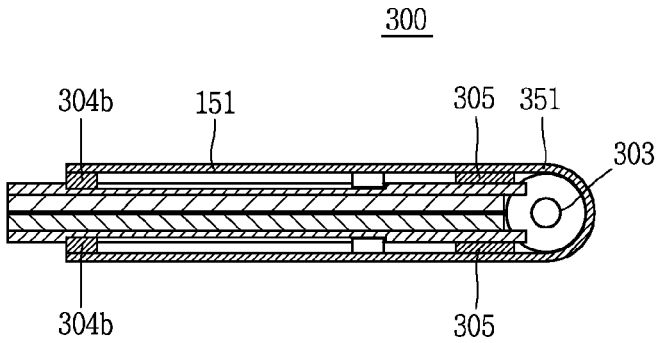

300
304b
151
305
351
303
304b
305

FIG. 6B

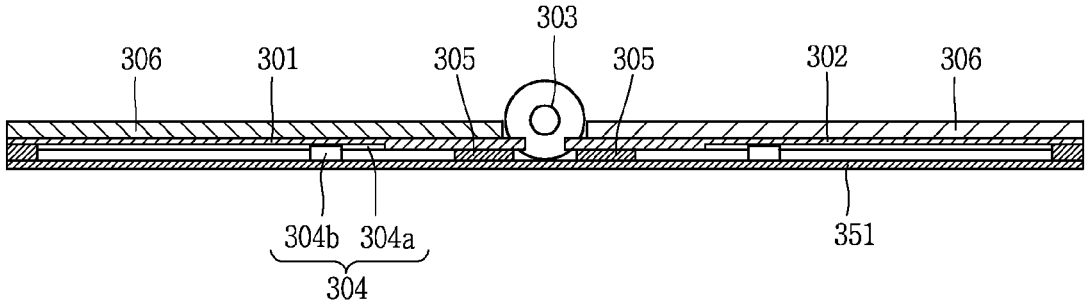

303
306
301
305
305
302
306
304b
304a
304
351

FIG. 7A

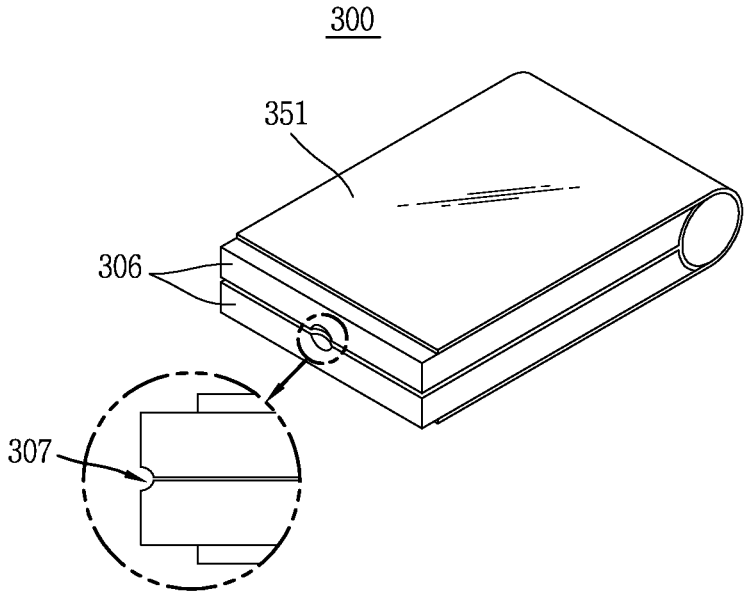


FIG. 7B

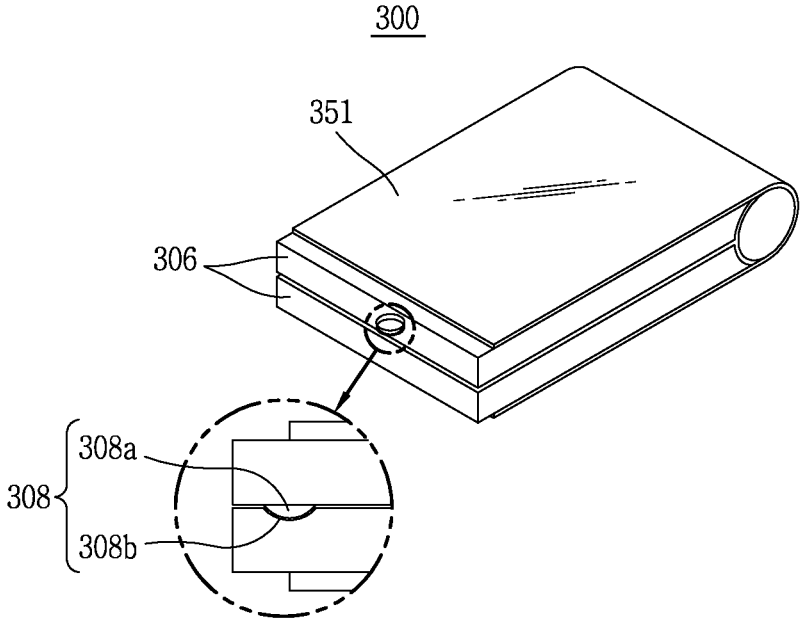


FIG. 8(a)

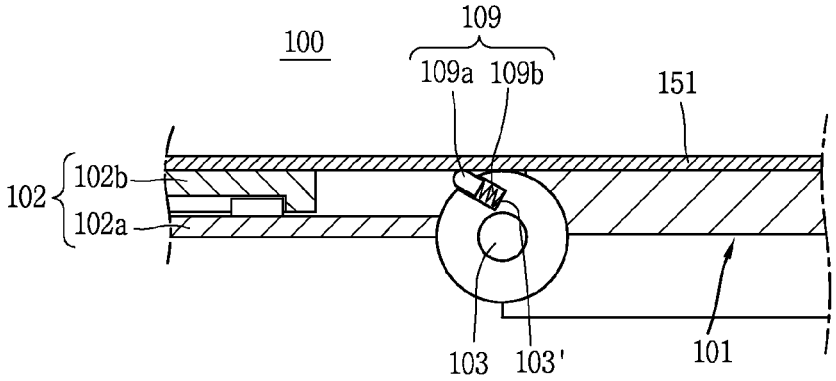


FIG. 8(b)

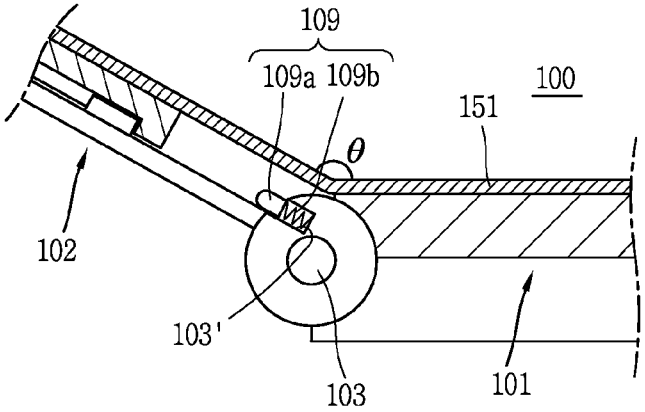
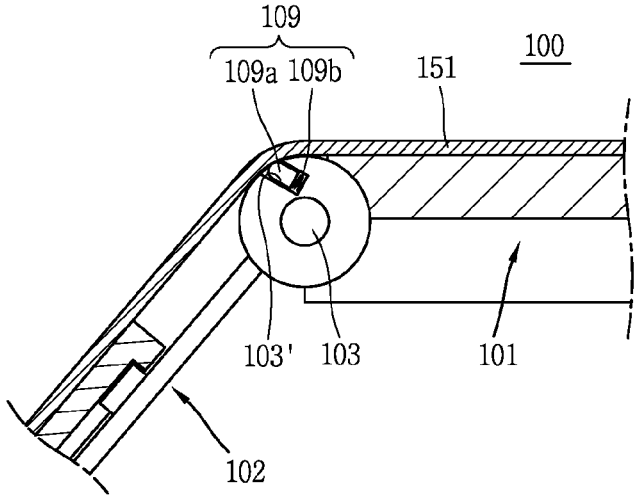


FIG. 8(c)



MOBILE TERMINAL

CROSS-REFERENCE TO RELATED APPLICATION

Pursuant to 35 U.S.C. §119(a), this application claims the benefit of earlier filing date and right of priority to Korean Application No. 10-2014-0117906, filed on Sep. 4, 2014, the contents of which are incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present disclosure relates to a mobile terminal having a display unit that can be deformed by an external force.

2. Background of the Invention

In general, a terminal may be classified into a mobile (portable) terminal and a stationary terminal according to a moveable state. The mobile terminal may be also classified into a handheld terminal and a vehicle mount terminal according to a user's carriage method.

As functions of the terminal become more diversified, the terminal can support more complicated functions such as capturing images or video, reproducing music or video files, playing games, receiving broadcast signals, and the like. By comprehensively and collectively implementing such functions, the mobile terminal may be embodied in the form of a multimedia player or a device. Efforts are ongoing to support and increase the functionality of mobile terminals. Such efforts include software and hardware improvements, as well as changes and improvements in the structural components.

Recently, mobile terminals including a flexible display that can be deformed by external force have been developed. In this case, however, if a flexible display unit is deformed to be folded or unfolded by using a hinge unit, the flexible display unit may be creased, degrading quality.

SUMMARY OF THE INVENTION

Therefore, an aspect of the detailed description is to provide a structure in which a flexible display unit is maintained to be flat while a mobile terminal is being deformed.

To achieve these and other advantages and in accordance with the purpose of this specification, as embodied and broadly described herein, a mobile terminal may include: a flexible display unit configured to be deformed from a first state as an unfolded state to a second state as a folded state or from the second state to the first state; a first body unit configured to support one region of the display unit; a second body unit rotatably connected to the first body unit, configured to support the other remaining region of the display unit, and configured to become away from the first body unit while the flexible display unit is being changed from the second state to the first state; and a hinge unit configured to rotatably connect the first and second body units.

In an example related to the present disclosure, the second body unit may include: a first plate rotatably mounted on the first body unit; and a second plate connected to the first plate so as to be slidably moved in a direction away from the first body unit when the display unit is being changed from the second state to the first state.

In an example related to the present disclosure, the first body unit may include a receiving space formed to be recessed on one surface of the first body unit to receive the second body unit and the other region of the flexible display unit in the second state.

In an example related to the present disclosure, the mobile terminal may further include an elastic unit configured to provide elastic force to move the second plate in the second state. Accordingly, the flexible display unit may be maintained in a more flat state in the first state, whereby output quality can be enhanced and damage to the flexible display unit due to a change in state of the flexible display unit can be minimized.

In an example related to the present disclosure, the mobile terminal may further include: connection units configured to connect the hinge unit and the first and second body units and elastic units provided to elastically support the connection units and the first and second body units.

In an example related to the present disclosure, the flexible display unit may include guide protrusions protruding from one surface of the flexible display unit and the first and second body units may include guide grooves allowing the guide protrusions to be inserted thereinto and extending in the one direction.

According to an exemplary embodiment of the present disclosure, in the mobile terminal having a flexible display unit formed to be folded with respect to the hinge unit, the flexible display unit may be maintained in an overall flat state by first and second plates that may be relatively movable by one region of the flexible display unit covering the hinge unit in the folded state.

Thus, even though the flexible display unit is deformed to be repeatedly unfolded or folded, damage to the folded region of the flexible display unit may be minimized. Also, quality of an image output to the folded region can be enhanced.

Further scope of applicability of the present application will become more apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate exemplary embodiments and together with the description serve to explain the principles of the invention.

In the drawings:

FIG. **1** is a block diagram illustrating a mobile terminal according to an exemplary embodiment of the present disclosure.

FIGS. **1**B(a) and **1**B(b) are conceptual views illustrating a mobile terminal including a flexible display unit.

FIGS. **2**A. **2**B, **2**C, **2**D(a), **2**D(b) and **2**D(c) are cross-sectional views of FIG. **1**B(a) illustrating a structure of a mobile terminal according to an exemplary embodiment of the present disclosure.

FIGS. **3**A, **3**B(a), and **3**B(b) are cross-sectional views illustrating a space for mounting an electronic component according to an exemplary embodiment of the present disclosure.

FIGS. **4**A(a), **4**A(b), **4**B, **4**C and **4**D are conceptual views specifically illustrating an additional structure providing tensile force to a flexible display unit in a second state.

FIGS. **5**A and **5**B are cross-sectional views illustrating a structure of a mobile terminal according to another exemplary embodiment of the present disclosure.

FIGS. **6**A and **6**B are cross-sectional views illustrating a structure of a mobile terminal according to another exemplary embodiment of the present disclosure.

FIGS. **7**A and **7**B are views illustrating a structure for moving or fixing body units in the second state.

FIGS. **8**(*a*), **8**(*b*) and **8**(*c*) are views illustrating a structure of a mobile terminal that can be deformed to a third state according to another exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

Description will now be given in detail according to exemplary embodiments disclosed herein, with reference to the accompanying drawings. For the sake of brief description with reference to the drawings, the same or equivalent components may be provided with the same or similar reference numbers, and description thereof will not be repeated. In general, a suffix such as "module" and "unit" may be used to refer to elements or components. Use of such a suffix herein is merely intended to facilitate description of the specification, and the suffix itself is not intended to give any special meaning or function. In the present disclosure, that which is well-known to one of ordinary skill in the relevant art has generally been omitted for the sake of brevity. The accompanying drawings are used to help easily understand various technical features and it should be understood that the embodiments presented herein are not limited by the accompanying drawings. As such, the present disclosure should be construed to extend to any alterations, equivalents and substitutes in addition to those which are particularly set out in the accompanying drawings.

It will be understood that although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are generally only used to distinguish one element from another.

It will be understood that when an element is referred to as being "connected with" another element, the element can be connected with the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly connected with" another element, there are no intervening elements present.

A singular representation may include a plural representation unless it represents a definitely different meaning from the context.

Terms such as "include" or "has" are used herein and should be understood that they are intended to indicate an existence of several components, functions or steps, disclosed in the specification, and it is also understood that greater or fewer components, functions, or steps may likewise be utilized.

Mobile terminals presented herein may be implemented using a variety of different types of terminals. Examples of such terminals include cellular phones, smart phones, user equipment, laptop computers, digital broadcast terminals, personal digital assistants (PDAs), portable multimedia players (PMPs), navigators, portable computers (PCs), slate PCs, tablet PCs, ultra books, wearable devices (for example, smart watches, smart glasses, head mounted displays (HMDs)), and the like.

By way of non-limiting example only, further description will be made with reference to particular types of mobile terminals. However, such teachings apply equally to other types of terminals, such as those types noted above. In addition, these teachings may also be applied to stationary terminals such as digital TV, desktop computers, and the like.

FIG. **1** is a block diagram of a mobile terminal in accordance with the present disclosure.

The mobile terminal **100** is shown having components such as a wireless communication unit **110**, an input unit **120**, a sensing unit **140**, an output unit **150**, an interface unit **160**, a memory **170**, a controller **180**, and a power supply unit **190**. It is understood that implementing all of the illustrated components is not a requirement, and that greater or fewer components may alternatively be implemented.

The wireless communication unit **110** typically includes one or more modules which permit communications such as wireless communications between the mobile terminal **100** and a wireless communication system, communications between the mobile terminal **100** and another mobile terminal, communications between the mobile terminal **100** and an external server.

Further, the wireless communication unit **110** typically includes one or more modules which connect the mobile terminal **100** to one or more networks. To facilitate such communications, the wireless communication unit **110** includes one or more of a broadcast receiving module **111**, a mobile communication module **112**, a wireless Internet module **113**, a short-range communication module **114**, and a location information module **115**.

The input unit **120** includes a camera **121** for obtaining images or video, a microphone **122**, which is one type of audio input device for inputting an audio signal, and a user input unit **123** (for example, a touch key, a push key, a mechanical key, a soft key, and the like) for allowing a user to input information. Data (for example, audio, video, image, and the like) is obtained by the input unit **120** and may be analyzed and processed by controller **180** according to device parameters, user commands, and combinations thereof.

The sensing unit **140** is typically implemented using one or more sensors configured to sense internal information of the mobile terminal, the surrounding environment of the mobile terminal, user information, and the like. For example, in FIG. **1**, the sensing unit **140** is shown having a proximity sensor **141** and an illumination sensor **142**. If desired, the sensing unit **140** may alternatively or additionally include other types of sensors or devices, such as a touch sensor, an acceleration sensor, a magnetic sensor, a G-sensor, a gyroscope sensor, a motion sensor, an RGB sensor, an infrared (IR) sensor, a finger scan sensor, a ultrasonic sensor, an optical sensor (for example, camera **121**), a microphone **122**, a battery gauge, an environment sensor (for example, a barometer, a hygrometer, a thermometer, a radiation detection sensor, a thermal sensor, and a gas sensor, among others), and a chemical sensor (for example, an electronic nose, a health care sensor, a biometric sensor, and the like), to name a few. The mobile terminal **100** may be configured to utilize information obtained from sensing unit **140**, and in particular, information obtained from one or more sensors of the sensing unit **140**, and combinations thereof.

The output unit **150** is typically configured to output various types of information, such as audio, video, tactile

output, and the like. The output unit **150** is shown having a display unit **151**, an audio output module **152**, a haptic module **153**, and an optical output module **154**.

The display unit **151** may have an inter-layered structure or an integrated structure with a touch sensor in order to facilitate a touch screen. The touch screen may provide an output interface between the mobile terminal **100** and a user, as well as function as the user input unit **123** which provides an input interface between the mobile terminal **100** and the user.

The interface unit **160** serves as an interface with various types of external devices that can be coupled to the mobile terminal **100**. The interface unit **160**, for example, may include any of wired or wireless ports, external power supply ports, wired or wireless data ports, memory card ports, ports for connecting a device having an identification module, audio input/output (I/O) ports, video I/O ports, earphone ports, and the like. In some cases, the mobile terminal **100** may perform assorted control functions associated with a connected external device, in response to the external device being connected to the interface unit **160**.

The memory **170** is typically implemented to store data to support various functions or features of the mobile terminal **100**. For instance, the memory **170** may be configured to store application programs executed in the mobile terminal **100**, data or instructions for operations of the mobile terminal **100**, and the like. Some of these application programs may be downloaded from an external server via wireless communication. Other application programs may be installed within the mobile terminal **100** at time of manufacturing or shipping, which is typically the case for basic functions of the mobile terminal **100** (for example, receiving a call, placing a call, receiving a message, sending a message, and the like). It is common for application programs to be stored in the memory **170**, installed in the mobile terminal **100**, and executed by the controller **180** to perform an operation (or function) for the mobile terminal **100**.

The controller **180** typically functions to control overall operation of the mobile terminal **100**, in addition to the operations associated with the application programs. The controller **180** may provide or process information or functions appropriate for a user by processing signals, data, information and the like, which are input or output by the various components depicted in FIG. **1**, or activating application programs stored in the memory **170**. As one example, the controller **180** controls some or all of the components illustrated in FIG. **1** according to the execution of an application program that have been stored in the memory **170**.

The power supply unit **190** can be configured to receive external power or provide internal power in order to supply appropriate power required for operating elements and components included in the mobile terminal **100**. The power supply unit **190** may include a battery, and the battery may be configured to be embedded in the terminal body, or configured to be detachable from the terminal body.

At least some of the above components may operate in a cooperating manner, so as to implement an operation or a control method of a glass type terminal according to various embodiments to be explained later. The operation or the control method of the glass type terminal may be implemented on the glass type terminal by driving at least one application program stored in the memory **170**.

Referring still to FIG. **1**, various components depicted in this figure will now be described in more detail.

Regarding the wireless communication unit **110**, the broadcast receiving module **111** is typically configured to receive a broadcast signal and/or broadcast associated information from an external broadcast managing entity via a broadcast channel. The broadcast channel may include a satellite channel, a terrestrial channel, or both. In some embodiments, two or more broadcast receiving modules **111** may be utilized to facilitate simultaneously receiving of two or more broadcast channels, or to support switching among broadcast channels.

The broadcast managing entity may be implemented using a server or system which generates and transmits a broadcast signal and/or broadcast associated information, or a server which receives a pre-generated broadcast signal and/or broadcast associated information, and sends such items to the mobile terminal. The broadcast signal may be implemented using any of a TV broadcast signal, a radio broadcast signal, a data broadcast signal, and combinations thereof, among others. The broadcast signal in some cases may further include a data broadcast signal combined with a TV or radio broadcast signal.

The broadcast signal may be encoded according to any of a variety of technical standards or broadcasting methods (for example, International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), Digital Video Broadcast (DVB), Advanced Television Systems Committee (ATSC), and the like) for transmission and reception of digital broadcast signals. The broadcast receiving module **111** can receive the digital broadcast signals using a method appropriate for the transmission method utilized.

Examples of broadcast associated information may include information associated with a broadcast channel, a broadcast program, a broadcast event, a broadcast service provider, or the like. The broadcast associated information may also be provided via a mobile communication network, and in this case, received by the mobile communication module **112**.

The broadcast associated information may be implemented in various formats. For instance, broadcast associated information may include an Electronic Program Guide (EPG) of Digital Multimedia Broadcasting (DMB), an Electronic Service Guide (ESG) of Digital Video Broadcast-Handheld (DVB-H), and the like. Broadcast signals and/or broadcast associated information received via the broadcast receiving module **111** may be stored in a suitable device, such as a memory **170**.

The mobile communication module **112** can transmit and/or receive wireless signals to and from one or more network entities. Typical examples of a network entity include a base station, an external mobile terminal, a server, and the like. Such network entities form part of a mobile communication network, which is constructed according to technical standards or communication methods for mobile communications (for example, Global System for Mobile Communication (GSM), Code Division Multi Access (CDMA), CDMA2000 (Code Division Multi Access 2000), EV-DO (Enhanced Voice-Data Optimized or Enhanced Voice-Data Only), Wideband CDMA (WCDMA), High Speed Downlink Packet access (HSDPA), HSUPA (High Speed Uplink Packet Access), Long Term Evolution (LTE), LTE-A (Long Term Evolution-Advanced), and the like).

Examples of wireless signals transmitted and/or received via the mobile communication module **112** include audio call signals, video (telephony) call signals, or various formats of data to support communication of text and multimedia messages.

The wireless Internet module **113** is configured to facilitate wireless Internet access. This module may be internally

or externally coupled to the mobile terminal **100**. The wireless Internet module **113** may transmit and/or receive wireless signals via communication networks according to wireless Internet technologies.

Examples of such wireless Internet access include Wireless LAN (WLAN), Wireless Fidelity (Wi-Fi), Wi-Fi Direct, Digital Living Network Alliance (DLNA), Wireless Broadband (WiBro), Worldwide Interoperability for Microwave Access (WiMAX), High Speed Downlink Packet Access (HSDPA), HSUPA (High Speed Uplink Packet Access), Long Term Evolution (LTE), LTE-A (Long Term Evolution-Advanced), and the like. The wireless Internet module **113** may transmit/receive data according to one or more of such wireless Internet technologies, and other Internet technologies as well.

In some embodiments, when the wireless Internet access is implemented according to, for example, WiBro, HSDPA, HSUPA, GSM, CDMA, WCDMA, LTE, LTE-A and the like, as part of a mobile communication network, the wireless Internet module **113** performs such wireless Internet access. As such, the Internet module **113** may cooperate with, or function as, the mobile communication module **112**.

The short-range communication module **114** is configured to facilitate short-range communications. Suitable technologies for implementing such short-range communications include BLUETOOTH™, Radio Frequency IDentification (RFID), Infrared Data Association (IrDA), Ultra-WideBand (UWB), ZigBee, Near Field Communication (NFC), Wireless-Fidelity (Wi-Fi), Wi-Fi Direct, Wireless USB (Wireless Universal Serial Bus), and the like. The short-range communication module **114** in general supports wireless communications between the mobile terminal **100** and a wireless communication system, communications between the mobile terminal **100** and another mobile terminal **100**, or communications between the mobile terminal and a network where another mobile terminal **100** (or an external server) is located, via wireless area networks. One example of the wireless area networks is a wireless personal area networks.

In some embodiments, another mobile terminal (which may be configured similarly to mobile terminal **100**) may be a wearable device, for example, a smart watch, a smart glass or a head mounted display (HMD), which is able to exchange data with the mobile terminal **100** (or otherwise cooperate with the mobile terminal **100**). The short-range communication module **114** may sense or recognize the wearable device, and permit communication between the wearable device and the mobile terminal **100**. In addition, when the sensed wearable device is a device which is authenticated to communicate with the mobile terminal **100**, the controller **180**, for example, may cause transmission of data processed in the mobile terminal **100** to the wearable device via the short-range communication module **114**. Hence, a user of the wearable device may use the data processed in the mobile terminal **100** on the wearable device. For example, when a call is received in the mobile terminal **100**, the user may answer the call using the wearable device. Also, when a message is received in the mobile terminal **100**, the user can check the received message using the wearable device.

The location information module **115** is generally configured to detect, calculate, derive or otherwise identify a position of the mobile terminal. As an example, the location information module **115** includes a Global Position System (GPS) module, a Wi-Fi module, or both. If desired, the location information module **115** may alternatively or additionally function with any of the other modules of the wireless communication unit **110** to obtain data related to the position of the mobile terminal.

As one example, when the mobile terminal uses a GPS module, a position of the mobile terminal may be acquired using a signal sent from a GPS satellite. As another example, when the mobile terminal uses the Wi-Fi module, a position of the mobile terminal can be acquired based on information related to a wireless access point (AP) which transmits or receives a wireless signal to or from the Wi-Fi module.

The input unit **120** may be configured to permit various types of input to the mobile terminal **120**. Examples of such input include audio, image, video, data, and user input. Image and video input is often obtained using one or more cameras **121**. Such cameras **121** may process image frames of still pictures or video obtained by image sensors in a video or image capture mode. The processed image frames can be displayed on the display unit **151** or stored in memory **170**. In some cases, the cameras **121** may be arranged in a matrix configuration to permit a plurality of images having various angles or focal points to be input to the mobile terminal **100**. As another example, the cameras **121** may be located in a stereoscopic arrangement to acquire left and right images for implementing a stereoscopic image.

The microphone **122** is generally implemented to permit audio input to the mobile terminal **100**. The audio input can be processed in various manners according to a function being executed in the mobile terminal **100**. If desired, the microphone **122** may include assorted noise removing algorithms to remove unwanted noise generated in the course of receiving the external audio.

The user input unit **123** is a component that permits input by a user. Such user input may enable the controller **180** to control operation of the mobile terminal **100**. The user input unit **123** may include one or more of a mechanical input element (for example, a key, a button located on a front and/or rear surface or a side surface of the mobile terminal **100**, a dome switch, a jog wheel, a jog switch, and the like), or a touch-sensitive input, among others. As one example, the touch-sensitive input may be a virtual key or a soft key, which is displayed on a touch screen through software processing, or a touch key which is located on the mobile terminal at a location that is other than the touch screen. On the other hand, the virtual key or the visual key may be displayed on the touch screen in various shapes, for example, graphic, text, icon, video, or a combination thereof.

The sensing unit **140** is generally configured to sense one or more of internal information of the mobile terminal, surrounding environment information of the mobile terminal, user information, or the like. The controller **180** generally cooperates with the sending unit **140** to control operation of the mobile terminal **100** or execute data processing, a function or an operation associated with an application program installed in the mobile terminal based on the sensing provided by the sensing unit **140**. The sensing unit **140** may be implemented using any of a variety of sensors, some of which will now be described in more detail.

The proximity sensor **141** may include a sensor to sense presence or absence of an object approaching a surface, or an object located near a surface, by using an electromagnetic field, infrared rays, or the like without a mechanical contact. The proximity sensor **141** may be arranged at an inner region of the mobile terminal covered by the touch screen, or near the touch screen.

The proximity sensor **141**, for example, may include any of a transmissive type photoelectric sensor, a direct reflective type photoelectric sensor, a mirror reflective type pho-

toelectric sensor, a high-frequency oscillation proximity sensor, a capacitance type proximity sensor, a magnetic type proximity sensor, an infrared rays proximity sensor, and the like. When the touch screen is implemented as a capacitance type, the proximity sensor **141** can sense proximity of a pointer relative to the touch screen by changes of an electromagnetic field, which is responsive to an approach of an object with conductivity. In this case, the touch screen (touch sensor) may also be categorized as a proximity sensor.

The term "proximity touch" will often be referred to herein to denote the scenario in which a pointer is positioned to be proximate to the touch screen without contacting the touch screen. The term "contact touch" will often be referred to herein to denote the scenario in which a pointer makes physical contact with the touch screen. For the position corresponding to the proximity touch of the pointer relative to the touch screen, such position will correspond to a position where the pointer is perpendicular to the touch screen. The proximity sensor **141** may sense proximity touch, and proximity touch patterns (for example, distance, direction, speed, time, position, moving status, and the like). In general, controller **180** processes data corresponding to proximity touches and proximity touch patterns sensed by the proximity sensor **141**, and cause output of visual information on the touch screen. In addition, the controller **180** can control the mobile terminal **100** to execute different operations or process different data according to whether a touch with respect to a point on the touch screen is either a proximity touch or a contact touch.

A touch sensor can sense a touch applied to the touch screen, such as display unit **151**, using any of a variety of touch methods. Examples of such touch methods include a resistive type, a capacitive type, an infrared type, and a magnetic field type, among others.

As one example, the touch sensor may be configured to convert changes of pressure applied to a specific part of the display unit **151**, or convert capacitance occurring at a specific part of the display unit **151**, into electric input signals. The touch sensor may also be configured to sense not only a touched position and a touched area, but also touch pressure and/or touch capacitance. A touch object is generally used to apply a touch input to the touch sensor. Examples of typical touch objects include a finger, a touch pen, a stylus pen, a pointer, or the like.

When a touch input is sensed by a touch sensor, corresponding signals may be transmitted to a touch controller. The touch controller may process the received signals, and then transmit corresponding data to the controller **180**. Accordingly, the controller **180** may sense which region of the display unit **151** has been touched. Here, the touch controller may be a component separate from the controller **180**, the controller **180**, and combinations thereof.

In some embodiments, the controller **180** may execute the same or different controls according to a type of touch object that touches the touch screen or a touch key provided in addition to the touch screen. Whether to execute the same or different control according to the object which provides a touch input may be decided based on a current operating state of the mobile terminal **100** or a currently executed application program, for example.

The touch sensor and the proximity sensor may be implemented individually, or in combination, to sense various types of touches. Such touches includes a short (or tap) touch, a long touch, a multi-touch, a drag touch, a flick touch, a pinch-in touch, a pinch-out touch, a swipe touch, a hovering touch, and the like.

If desired, an ultrasonic sensor may be implemented to recognize position information relating to a touch object using ultrasonic waves. The controller **180**, for example, may calculate a position of a wave generation source based on information sensed by an illumination sensor and a plurality of ultrasonic sensors. Since light is much faster than ultrasonic waves, the time for which the light reaches the optical sensor is much shorter than the time for which the ultrasonic wave reaches the ultrasonic sensor. The position of the wave generation source may be calculated using this fact. For instance, the position of the wave generation source may be calculated using the time difference from the time that the ultrasonic wave reaches the sensor based on the light as a reference signal.

The camera **121** typically includes at least one a camera sensor (CCD, CMOS etc.), a photo sensor (or image sensors), and a laser sensor.

Implementing the camera **121** with a laser sensor may allow detection of a touch of a physical object with respect to a 3D stereoscopic image. The photo sensor may be laminated on, or overlapped with, the display device. The photo sensor may be configured to scan movement of the physical object in proximity to the touch screen. In more detail, the photo sensor may include photo diodes and transistors at rows and columns to scan content received at the photo sensor using an electrical signal which changes according to the quantity of applied light. Namely, the photo sensor may calculate the coordinates of the physical object according to variation of light to thus obtain position information of the physical object.

The display unit **151** is generally configured to output information processed in the mobile terminal **100**. For example, the display unit **151** may display execution screen information of an application program executing at the mobile terminal **100** or user interface (UI) and graphic user interface (GUI) information in response to the execution screen information.

In some embodiments, the display unit **151** may be implemented as a stereoscopic display unit for displaying stereoscopic images.

A typical stereoscopic display unit may employ a stereoscopic display scheme such as a stereoscopic scheme (a glass scheme), an auto-stereoscopic scheme (glassless scheme), a projection scheme (holographic scheme), or the like.

The audio output module **152** is generally configured to output audio data. Such audio data may be obtained from any of a number of different sources, such that the audio data may be received from the wireless communication unit **110** or may have been stored in the memory **170**. The audio data may be output during modes such as a signal reception mode, a call mode, a record mode, a voice recognition mode, a broadcast reception mode, and the like. The audio output module **152** can provide audible output related to a particular function (e.g., a call signal reception sound, a message reception sound, etc.) performed by the mobile terminal **100**. The audio output module **152** may also be implemented as a receiver, a speaker, a buzzer, or the like.

A haptic module **153** can be configured to generate various tactile effects that a user feels, perceive, or otherwise experience. A typical example of a tactile effect generated by the haptic module **153** is vibration. The strength, pattern and the like of the vibration generated by the haptic module **153** can be controlled by user selection or setting by the controller. For example, the haptic module **153** may output different vibrations in a combining manner or a sequential manner.

Besides vibration, the haptic module **153** can generate various other tactile effects, including an effect by stimulation such as a pin arrangement vertically moving to contact skin, a spray force or suction force of air through a jet orifice or a suction opening, a touch to the skin, a contact of an electrode, electrostatic force, an effect by reproducing the sense of cold and warmth using an element that can absorb or generate heat, and the like.

The haptic module **153** can also be implemented to allow the user to feel a tactile effect through a muscle sensation such as the user's fingers or arm, as well as transferring the tactile effect through direct contact. Two or more haptic modules **153** may be provided according to the particular configuration of the mobile terminal **100**.

An optical output module **154** can output a signal for indicating an event generation using light of a light source. Examples of events generated in the mobile terminal **100** may include message reception, call signal reception, a missed call, an alarm, a schedule notice, an email reception, information reception through an application, and the like.

A signal output by the optical output module **154** may be implemented in such a manner that the mobile terminal emits monochromatic light or light with a plurality of colors. The signal output may be terminated as the mobile terminal senses that a user has checked the generated event, for example.

The interface unit **160** serves as an interface for external devices to be connected with the mobile terminal **100**. For example, the interface unit **160** can receive data transmitted from an external device, receive power to transfer to elements and components within the mobile terminal **100**, or transmit internal data of the mobile terminal **100** to such external device. The interface unit **160** may include wired or wireless headset ports, external power supply ports, wired or wireless data ports, memory card ports, ports for connecting a device having an identification module, audio input/output (I/O) ports, video I/O ports, earphone ports, or the like.

The identification module may be a chip that stores various information for authenticating authority of using the mobile terminal **100** and may include a user identity module (UIM), a subscriber identity module (SIM), a universal subscriber identity module (USIM), and the like. In addition, the device having the identification module (also referred to herein as an "identifying device") may take the form of a smart card. Accordingly, the identifying device can be connected with the terminal **100** via the interface unit **160**.

When the mobile terminal **100** is connected with an external cradle, the interface unit **160** can serve as a passage to allow power from the cradle to be supplied to the mobile terminal **100** or may serve as a passage to allow various command signals input by the user from the cradle to be transferred to the mobile terminal there through. Various command signals or power input from the cradle may operate as signals for recognizing that the mobile terminal is properly mounted on the cradle.

The memory **170** can store programs to support operations of the controller **180** and store input/output data (for example, phonebook, messages, still images, videos, etc.). The memory **170** may store data related to various patterns of vibrations and audio which are output in response to touch inputs on the touch screen.

The memory **170** may include one or more types of storage mediums including a Flash memory, a hard disk, a solid state disk, a silicon disk, a multimedia card micro type, a card-type memory (e.g., SD or DX memory, etc), a Random Access Memory (RAM), a Static Random Access Memory (SRAM), a Read-Only Memory (ROM), an Electrically Erasable Programmable Read-Only Memory (EEPROM), a Programmable Read-Only memory (PROM), a magnetic memory, a magnetic disk, an optical disk, and the like. The mobile terminal **100** may also be operated in relation to a network storage device that performs the storage function of the memory **170** over a network, such as the Internet.

The controller **180** may typically control the general operations of the mobile terminal **100**. For example, the controller **180** may set or release a lock state for restricting a user from inputting a control command with respect to applications when a status of the mobile terminal meets a preset condition.

The controller **180** can also perform the controlling and processing associated with voice calls, data communications, video calls, and the like, or perform pattern recognition processing to recognize a handwriting input or a picture drawing input performed on the touch screen as characters or images, respectively. In addition, the controller **180** can control one or a combination of those components in order to implement various exemplary embodiments disclosed herein.

The power supply unit **190** receives external power or provide internal power and supply the appropriate power required for operating respective elements and components included in the mobile terminal **100**. The power supply unit **190** may include a battery, which is typically rechargeable or be detachably coupled to the terminal body for charging.

The power supply unit **190** may include a connection port. The connection port may be configured as one example of the interface unit **160** to which an external charger for supplying power to recharge the battery is electrically connected.

As another example, the power supply unit **190** may be configured to recharge the battery in a wireless manner without use of the connection port. In this example, the power supply unit **190** can receive power, transferred from an external wireless power transmitter, using at least one of an inductive coupling method which is based on magnetic induction or a magnetic resonance coupling method which is based on electromagnetic resonance.

Various embodiments described herein may be implemented in a computer-readable medium, a machine-readable medium, or similar medium using, for example, software, hardware, or any combination thereof.

The display unit **151** outputs information processed in the mobile terminal **100**. For example, the display unit **151** may display information on an execution screen of an application program driven in the mobile terminal **100**, or a User Interface (UI) or a Graphic User Interface (GUI) associated with such execution screen information.

The display unit **151** may be implemented using one or more suitable display devices. Examples of such suitable display devices include a liquid crystal display (LCD), a thin film transistor-liquid crystal display (TFT-LCD), an organic light emitting diode (OLED), a flexible display, a 3-dimensional (3D) display, an e-ink display, and combinations thereof.

The display unit **151** may be implemented using two display devices, which can implement the same or different display technology. For instance, a plurality of the display units **151** may be arranged on one side, either spaced apart from each other, or these devices may be integrated, or these devices may be arranged on different surfaces.

The display unit **151** may also include a touch sensor which senses a touch input received at the display unit. When a touch is input to the display unit **151**, the touch

sensor may be configured to sense this touch and the controller **180**, for example, may generate a control command or other signal corresponding to the touch. The content which is input in the touching manner may be a text or numerical value, or a menu item which can be indicated or designated in various modes.

The microphone **122** is shown located at an end of the mobile terminal **100**, but other locations are possible. If desired, multiple microphones may be implemented, with such an arrangement permitting the receiving of stereo sounds.

The interface unit **160** may serve as a path allowing the mobile terminal **100** to interface with external devices. For example, the interface unit **160** may include one or more of a connection terminal for connecting to another device (for example, an earphone, an external speaker, or the like), a port for near field communication (for example, an Infrared Data Association (IrDA) port, a Bluetooth port, a wireless LAN port, and the like), or a power supply terminal for supplying power to the mobile terminal **100**. The interface unit **160** may be implemented in the form of a socket for accommodating an external card, such as Subscriber Identification Module (SIM), User Identity Module (UIM), or a memory card for information storage.

At least one antenna for wireless communication may be located on the terminal body. The antenna may be installed in the terminal body or formed by the case. For example, an antenna which configures a part of the broadcast receiving module **111** (refer to FIG. **1**) may be retractable into the terminal body. Alternatively, an antenna may be formed using a film attached to an inner surface of the rear cover **103**, or a case that includes a conductive material.

A power supply unit **190** for supplying power to the mobile terminal **100** may include a battery **191**, which is mounted in the terminal body or detachably coupled to an outside of the terminal body. The battery **191** may receive power via a power source cable connected to the interface unit **160**. Also, the battery **191** can be recharged in a wireless manner using a wireless charger. Wireless charging may be implemented by magnetic induction or electromagnetic resonance.

The rear cover **103** is shown coupled to the rear case **102** for shielding the battery **191**, to prevent separation of the battery **191**, and to protect the battery **191** from an external impact or from foreign material. When the battery **191** is detachable from the terminal body, the rear case **103** may be detachably coupled to the rear case **102**.

An accessory for protecting an appearance or assisting or extending the functions of the mobile terminal **100** can also be provided on the mobile terminal **100**. As one example of an accessory, a cover or pouch for covering or accommodating at least one surface of the mobile terminal **100** may be provided. The cover or pouch may cooperate with the display unit **151** to extend the function of the mobile terminal **100**. Another example of the accessory is a touch pen for assisting or extending a touch input to a touch screen.

FIG. **1**B is a conceptual view illustrating a mobile terminal including a flexible display unit. The mobile terminal according to an exemplary embodiment of the present disclosure includes a flexible display unit **151** that may be deformed by an external force applied thereto. The deformation may be at least one among bending, folding, twisting, and rolling of the display module. The deformable display module may be referred to as a "flexible display unit". Here, the flexible display unit **151** may include all of a general flexible display, e-paper, and a combination thereof.

A general flexible display refers to a display fabricated on a thin, flexible substrate which is pliable, bendable, foldable, twistable, or rollable, while maintaining characteristics of an existing flat panel display, which, thus, is light in weight and not brittle.

Also, e-paper refers to a display technique employing the characteristics of general ink. A difference of e-paler from an existing flat panel display lies in that e-paper uses reflected light. In e-paper, information may be changed by using twist balls or electrophoresis using capsules.

In a state in which the flexible display unit **151** is not deformed (for example, in a state in which the flexible display unit **151** has an infinite radius of curvature) (hereinafter, referred to as a "first state"), a display region of the flexible display unit **151** is flat. When the flexible display unit **151** is deformed by an external force in the first state (for example, a state in which the flexible display unit **151** has a finite radius of curvature, which will be referred to as a "second state, hereinafter), the display region may be curved.

As illustrated, information displayed in the second state may be visual information output on a curved surface. Such visual information is displayed as light emission of unit pixels (subpixels) disposed in a matrix form is independently controlled. A unit pixel refers to a minimum unit for implementing a single color.

The flexible display unit **151** may be changed from a first state, that is, in a flat state, to a bent state (for example, vertically or horizontally bent state). In this case, when an external force is applied to the flexible display unit **151**, the flexible display unit **151** may be deformed to be flat state (or less bent state) or more bent state.

Meanwhile, the flexible display unit **151** may be combined with a touch sensor to implement a flexible touch screen. When a touch is applied to the flexible touch screen, the controller **180** (please refer to FIG. **1**) may perform controlling corresponding to the touch input. The flexible touch screen may be configured to sense a touch input even in the second state, as well as in the first state.

Meanwhile, a deformation sensing unit for sensing deformation of the flexible display unit **151** may be provided in the mobile terminal **100** according to the present modified example. Such a deformation sensing unit may be included in the sensing unit **140** (please refer to FIG. **1**).

The deformation sensing unit may be provided in the flexible display unit **151** or the body unit **101** or **102** to sense information related to deformation of the flexible display unit **151**. Here, information related to deformation may include a direction in which the flexible display unit **151** is deformed, a degree to which the flexible display unit **151** is deformed, a deformed position of the flexible display unit **151**, a period of time during which the flexible display unit **151** is deformed, acceleration at which the flexible display unit **151** in a deformed state is restored. In addition, the information related to deformation may be various types of information that can be sensed when the flexible display unit **151** is bent.

Also, on the basis of information related to deformation of the flexible display unit **151** sensed by the deformation sensing unit, the controller **180** may change information displayed on the flexible display unit **151** or may generate a control signal for controlling a function of the mobile terminal **100**.

Deformation of a state of the flexible display unit **151** is not induced by only an external force. For example, when the flexible display unit **151** is in the first state, the flexible

display unit **151** may be deformed to the second state by the user or by a command of an application.

The mobile terminal **100** according to an exemplary embodiment of the present disclosure is supported by the first and second body units **101** and **102**, and the first and second body units **101** and **102** are rotatably connected. The first body unit **101** supports one region of the flexible display unit **151** and the second body unit **102** supports the other region of the flexible display unit **151**. The first and second body units **101** and **102** relatively rotate at a certain angle in a mutually connected state, the region of the flexible display unit **151** connecting the first and second body unit **101** and **102** is bent, and the flexible display unit **151** turns to the second state in which portions thereof overlap with each other in the second state.

FIG. **1**B(a) is a conceptual view illustrating the second state in which the flexible display unit **151** is folded, and FIG. **1**B(b) is a conceptual view illustrating a first state in which the flexible display unit **151** is unfolded. In the drawings, only the first and second states are illustrated, but there may be another state in which one region and the other remaining region of the flexible display unit **151** are bent at a certain angle, while the flexible display unit **151** is deformed from the first state to the second state.

In the second state, the first and second body units **101** and **102** overlap with each other, and a space between the one region and the other remaining region are bent, forming a curved surface.

The first and second body units **101** and **102** include preset bezel portions formed to surround the edges of the flexible display unit **151**, and the first and second body units **101** and **102** have preset thicknesses, respectively. A plurality of electronic components for driving the mobile terminal **100** are mounted in one region of at least one of the first and second body units **101** and **102**.

Hereinafter, a specific structure in which the flexible display unit **151** is deformed in a state of being tightly attached to the body units, while the flexible display unit **151** is fixed to the body units having preset shapes and is changed from the first state to the second state or from the second state to the first state will be described.

FIGS. **2**A. **2**B, **2**C, **2**D(a), **2**D(b) through and **2**D(c) are cross-sectional views of FIG. **1**B(a) illustrating a structure of a mobile terminal according to an exemplary embodiment of the present disclosure. The mobile terminal **100** according to an exemplary embodiment of the present disclosure includes a flexible display unit **151**, the first and second body units **101** and **102** supporting the flexible display unit **151**, and a hinge unit **103**.

The first and second body units **101** and **102** are rotatably connected by the hinge unit **103**. The hinge unit **103** includes a hinge shaft (not shown), and connection portions formed to surround one region of the hinge shaft may be formed in one end portions of the first and second body units **101** and **102**.

The flexible display unit **151** is attached on one surface of the first body unit **101**. Although not shown in detail in the drawings, an adhesive member may be formed between the first body unit **101** and the flexible display unit **151**. Also, a receiving portion may be formed to be recessed from one surface of the first body unit **101** to receive one region of the flexible display unit **151**.

Also, the first body unit **101** includes a receiving space **101'** formed to be recessed from the other surface opposing the one surface to receive the other remaining region of the flexible display unit **151**. Referring to FIGS. **2**A and **2**B, the internal space **101'** may have a depth d**1** substantially equal to the thickness of the flexible display unit **151** and the second body **102**. Referring to FIG. **2**A, in the second state as a folded state, both the flexible display unit **151** and the second body unit **102** may be received in the internal space **101'**, and in the second state, the other surface of the first body unit **101** and the exposed outer surface of the display unit **151** may be maintained to be substantially flat.

The hinge unit **103** is fixed to the first body unit **101** on the flexible display unit **151**, and one end portion of the first body unit **101** may be connected to the hinge portion **103**. Here, preferably, one end portion of the first body unit **101** is connected to a lower portion, relative to the hinge shaft.

Meanwhile, one end portion of the second body **102** is connected to the hinge unit **103**, and here, the one end portion of the second body unit **102** may be connected to a portion lower than the hinge shaft (not shown). The second body unit **102** includes first and second plates **102***a* and **102***b* which are formed to be slidable with each other.

The first plate **102***a* is connected to the hinge unit **103** so as to be relatively rotated from the first body unit **101** with respect to the hinge shaft. In order to allow the first and second body units **101** and **102** having preset thicknesses to completely overlap with each other, the first plate **102***a* may be connected to a portion lower than the position of the hinge shaft, the center of the hinge unit **103**. The first plate **102***a* may further include a connection portion covering one region of the hinge unit **103**.

One surface of the second plate **102***b* is installed to be slidably moved to the first plate **102***a*. In the second state, end portions of the first and second plates **102***a* and **102***b* overlap with each other to form a single end portion. Meanwhile, in the second state, one regions of the first and second plates **102***a* and **102***b* partially overlap with each other.

The other remaining region of the flexible display unit **151** is installed on the other surface of the second plate **102***b*. Although not illustrated in detail in the drawings, an adhesive member may be formed between the flexible display unit **151** and the other surface of the second plate **102***b*.

The flexible display unit **151** includes a region fixed to the body **101**, a region fixed to the second unit **102**, and an unattached region S. In the second state, the unattached region S is formed to cover a portion of an outer circumferential surface of the hinge unit **103**, and in the first state, the unattached region S may be restricted from being in contact with other components and may form a space with the first plate **102***a*.

For a slidable movement of the first plate **102***a* and the second plate **102***b*, the second body unit **102** includes a movement guide unit **104**. In a state in which the flexible display unit **151** is attached, the movement guide unit **104** guides the second plate **102***b* to reciprocate in a direction in which the display unit extends with respect to the first plate **102***a*, namely, in a first direction D**1** on the drawing.

FIG. **2**C is a conceptual view of FIG. **2**B viewed in an A direction, illustrating a guide unit according to an exemplary embodiment of the present disclosure.

FIG. **2**C is a conceptual view illustrating the mobile terminal in the first state. The first and second plates **102***a* and **120***b* are partially overlapped state, and the receiving space **101'** is exposed.

Referring to FIGS. **2**B and **2**C, the guide unit includes a guide groove **104***a* and a guide protrusion **104***b*. The guide groove **104***a* extends in the first direction D**1**, and recessed from the other surface of the second plate **102***b*. The guide protrusion **104***b* is formed to be inserted into the guide groove **104***b*, and protrude from one surface of the first plate

102*a*. The guide protrusion **104***b* may have a cross-section having an I shape such that it may not be separated from the guide groove **104***a*. Accordingly, when an external force is applied by the user, the second plate **102***b* moves in a direction away from the first body unit **101**, namely, in a direction away from the hinge unit **103**, along the guide groove **104***a*, and thus, the unattached region S is under tensile force applied from the first and second body units **101** and **102** so as to be maintained to be flat in the first state. Hereinafter, a deformed state of the flexible display unit **151** according to the structure of the second body unit **102** will be described.

FIGS. **2**D(a), **2**D(b) and **2**D(c) are conceptual views illustrating a movement of the structure of the mobile terminal according to an exemplary embodiment of the present disclosure.

FIG. **2**D(a) is a partial cross-sectional view of the mobile terminal **100** in the first state, and **2**D(c) is a partial cross-sectional view of the mobile terminal **100** in the second state, and FIG. **2**D(b) is a view illustrating an intermediate state in deformation from the first state to the second state (or vice versa).

a length between a first end portion **102***a*' of the first plate **102***a* and a second end portion **102***b*' of the second plate **102***b* in the first state will be defined as a first length l1. Referring to FIGS. **2**D and **2**B, the first length l1 is formed to be smaller than or substantially equal to the unattached region S.

FIG. **2**D(b) illustrates a state in which the second body unit **102** relatively rotates with respect to the first body unit **101** such that the first body unit **101** and the first plate **102***a* are at a particular angle. In this case, a length between the first and second end portions **102***a*' and **102***b*' is a second length l2, and the second length l2 is smaller than the first length l1. Also, a portion of the unattached region S covers a portion of an outer circumferential surface of the hinge unit **103**.

Referring to FIG. **2**D(c), in the second state, the first and second body units **101** and **102** are received in the receiving region **101**'. That is, the sequentially overlapped first and second body units **101** and **102** and the other region of the flexible display unit **151** are received in the receiving region **101**'. The flexible display unit **151** and an outer surface of the first body unit **101** may form a plane. In this case, the length between the first and second end portions **102**' and **102***b*' substantially disappear and the first and second end portions **102***a*' and **102***b*' may form the substantially same end portions.

In the second state, the flexible display unit **151** may be formed to cover a half of an outer circumference of the hinge unit **151**. That is, the first length l1 may be formed to be substantially equal to the length corresponding to the half of the outer circumference of the hinge unit.

Thus, in the mobile terminal **100** having the flexible display unit **151** formed to be bent and folded with respect to the hinge unit formed to have a preset diameter, the flexible display unit **151** may be maintained in an overall flat state in the unfolded state by the first and second plates **102***a* and **102***b* that can be relatively movable by one region of the flexible display unit **151** covering the hinge unit in the folded state.

Thus, although the flexible display unit **151** is repeatedly deformed, namely, repeatedly folded and unfolded, damage to the folded region of the flexible display unit **151** can be minimized. Also, image output quality in the folded region can be enhanced.

Electronic components for driving the mobile terminal **100** may be mounted on at least a portion of the first and second body units **101** and **102** of the mobile terminal **100**. FIGS. **3**A, **3**B(a), and **3**B(b) are cross-sectional views illustrating a space for mounting an electronic component according to an exemplary embodiment of the present disclosure.

Referring to FIGS. **2**B and **3**A, the first body unit **101** includes the receiving space **101**' having the first thickness d1 to receive the second body unit **102** and the flexible display unit **151** in the second state. Also, a first mounting space allowing the electronic component to be mounted therein is provided in the other end portion of the first body unit **101** having one end portion connected to the hinge unit **103**. The receiving space **101**' may be formed by a length over which the flexible display unit **151** extends, the thickness d1 of the receiving space **101**', and a radius from the center of the hinge unit **103**.

For example, a power supply unit **190** may be mounted in the first mounting space. The first mounting space is a region having a relatively large thickness, and thus, a battery having increased capacity, and the like, may be mounted in the first mounting space. That is, the first mounting space is disposed to be adjacent to the second body unit **102** in the second state.

Also, the first body unit **101** has a thickness formed between the one surface of the first body unit **101** on which the flexible display unit **151** is attached and the receiving space **101**' by the radius of the hinge unit **103**. Accordingly, a circuit board **181**, or the like, forming an electrical signal according to an electronic component may be mounted in a second mounting space formed due to the preset thickness of the first body unit **101**.

The second mounting space may have an area substantially the same as that of one region in which the flexible display unit **151** is attached to the first body unit **101**. However, the electronic components mounted in the first and second mounting regions are not limited thereto and shapes and relative sizes of the first and second mounting spaces are not limited to those illustrated in the drawings.

A mounting space of an electronic component according to another exemplary embodiment of the present disclosure will be described with reference to FIGS. **3**B(a) and **3**B(b). The first body unit **101** of the mobile terminal **100** according to the present exemplary embodiment does not form the receiving space **101**' of FIG. **3**A. Referring to FIG. **3**B(b), the second body unit **102** attached to the flexible display unit **151** in the second state is formed to overlap on the first body unit **101**. FIG. **3**B(a) is a cross-sectional view of the mobile terminal **100** in the first state, and FIG. **3**B(b) is a cross-sectional view of the mobile terminal **100** in the second state.

Referring to FIG. **3**B(a), in the first state, the first and second body units **101** and **102** are formed to have the substantially same thickness with respect to the flexible display unit **151**.

In this case, the electronic component may be mounted by using thicknesses of the first and second body units **101** and **102**. For example, the power supply unit **190** formed to be wide and thin may be mounted in the first mounting space of the first body unit, and the circuit board **181** my be disposed in the second mounting region of the second body unit **102**.

In the mobile terminal **100** according to the present disclosure, the first and second body units **101** and **102** extend to correspond to the area of the flexible display unit **151**, and thus, a wider and thinner mounting space may be

provided. Also, since the mounting space is formed in both the first and second body units **101** and **102**, the first and second body units **101** and **102** may be formed to be balanced in weight.

The flexible display unit **151** is provided with tensile force so as to be deformed to be flat according to the second plate **102***b* moved by an external force from the user. Hereinafter, an additional structure providing tensile force to the flexible display unit will be described in detail.

The mobile terminal **100** including an elastic member according to an exemplary embodiment of the present disclosure will be described with reference to FIGS. **2**D(a), **2**D(b), **2**D(c), **4**A(a) and **4**A(b). The mobile terminal **100** according to the present exemplary embodiment includes a side wall portion **102***c* formed to surround the edges of the first and second plates **102***a* and **120***b* and the edges of the flexible display unit **151**. the side wall portion **102***c* may be formed to be substantially equal to a total thickness of the flexible display unit **151** and the first and second plates **102***a* and **120***b*. That is, in the first state, a space having a first length l**1** is formed between a first end portion **102***a*' of the first plate **102***a* and the side wall portion **102***c*. Also, the side wall portion **102***c* is fixed to a second end portion **102***b*'.

The mobile terminal **100** according to the present exemplary embodiment further includes first elastic members **170***a* formed in the space to elastically support the side wall portion **102***c* and the first plate **102***a*. The side wall portion **102***c* and the first plate **102***a* are forced to become away from one another due to elastic force of the first elastic members **107***a*, and accordingly, the second plate **102***b* and the first plate **102***a* fixed to the side wall portion **102***c* are under tensile force exerted to make the second plate **102***b* and the first plate **102***a* become away. Also, the side wall portion **102***c* has a first recess **102***c*' having a preset depth such that the first elastic members **170***a* are received therein.

That is, in the first state, tensile force may be applied to the unattached region S of the flexible display unit **151** due to elastic force provided between the first and second plates **102***a* and **120***b* in the first state.

Referring to FIG. **4**A(b), the first elastic member **107***a* may be deformed by external force of the user applied while the mobile terminal is deformed to the second state. Although not shown in detail in the drawings, when the mobile terminal is changed to the second state, the first electric members **107***a* may be received in the first recess **102***c*'.

According to the present exemplary embodiment, since elastic force is provided between the first and second plates **102***a* and **120***b* to provide the second plate **102***a* with a force to make it move, the unattached region S of the flexible display unit **151** may be formed to be more flat.

The mobile terminal **100** including a second elastic member formed in the second body unit will be described with reference to FIG. **4**B. The second plate **102***b* includes a second recess **102**' recessed from the other end portion of the second plate **102***b*, namely, from an end portion facing the hinge unit **103** in the first state. Also, the second body unit **102** includes a second elastic member **107***b* having a portion received in the second recess **102**' and supporting the second plate **102***b* and the hinge unit **103**.

A force thrusting the second plate **102***b* from the hinge unit **103** is provided in the first state due to elastic force of the second elastic member **107***b*. Accordingly, the second plate **102***b* may move farther by virtue of the elastic force and the unattached region S may become more flat.

The mobile terminal **100** having a third elastic member **107***c* received in the guide unit will be described with reference to FIGS. **2**C and **4**C.

The mobile terminal **100** according to the present exemplary embodiment may include a plurality of guide protrusions **104***b*. For example, the guide unit **104** may include a first guide protrusion **104***b*' disposed to be most adjacent to the hinge unit **103** and a second guide protrusion **104***b*" disposed to be farthest from the hinge unit **103**. The guide groove **104***a* is formed such that a distance over which the first and second guide protrusions **104***b*' and **104***b*" move when the mobile terminal **100** is changed from the second state to the first state is substantially equal to the first length l**1**.

The third elastic member **107***c* according to the present exemplary embodiment is received in the guide groove **104***a* and elastically supports the second guide protrusion **104***b*" and an inner surface forming the guide groove **104***a* of the second plate **102***b*.

A third length l**3** between the second guide protrusion **104***b*" and an inner surface of the second plate **102***b* forming the guide groove **104***a* in the first state is greater than the first length l**1**. Also, the third elastic member **107***c* contracts in the second state, and a fourth length l**4** of a space formed to receive the third elastic member **107***c* between the second guide protrusion **104***b*" and an inner surface of the second plate **102***b* is smaller than the first length l**1**.

Preferably, third elastic members **107***c* may be formed to correspond to the number of guide units. The third elastic member **107***c* is not exposed to the outside of the mobile terminal **100**, a simple appearance can be provided.

The structure of the mobile terminal **100** including a deformation guide member will be described with reference to FIG. **4**D. The mobile terminal according to the present exemplary embodiment may further include a deformation guide member **106** attached to the flexible display unit **151**. The deformation guide member **106** may be formed of a material deformed by itself such that the flexible display unit **151** becomes flat when the mobile terminal **100** is changed to the first state.

For example, the deformation guide member **106** may be formed of an elastic member having elastic force for becoming flat, or may be formed as a bending sensor that may be changeable to a desired shape and as a shape memory member having a force to be deformed to a preset shape by an electric signal.

The deformation guide member **106** may be formed in one region or in the entire region of the flexible display unit **151**. Preferably, the deformation guide member **106** may be formed in the unattached region S and formed to extend in a first direction D**1**.

According to the present exemplary embodiment, since the deformation guide member **106** is directly installed on the flexible display unit **151**, without any additional structure installed in each component to provide tensile force, durability can be enhanced.

FIGS. **5**A and **5**B are cross-sectional views illustrating a structure of a mobile terminal according to another exemplary embodiment of the present disclosure. FIG. **5**A is a cross-sectional view illustrating a mobile terminal in the first state according to the present exemplary embodiment, and FIG. **5**B is a cross-sectional view illustrating a mobile terminal in the second state according to the present exemplary embodiment.

A mobile terminal **200** according to an exemplary embodiment of the present disclosure includes a flexible display unit **251**, first and second body units **201** and **202**

supporting the flexible display unit **251**, and a hinge unit **203** connecting the first and second body units **201** and **202** such that the first and second body units **201** and **202** relatively rotate with each other. The flexible display unit **251** is substantially identical to the flexible display unit **151** of FIG. **2**A, and redundant descriptions thereof will be omitted.

The mobile terminal **200** includes connection units **204** and elastic units **205** in order to connect the first and second body units **201** and **202** to the hinge unit **203**. The first and second body units **201** and **202** include first and second insertion recesses **201'** and **202'**, respectively. The first and second insertion recesses **201'** and **202'** are formed to face each other in the first state.

The connection units **204** include first and second connection members **204***a* and **204***b* inserted into the first and second insertion recesses **201'** and **202'**, respectively. Also, the elastic units **205** include first and second elastic members **205***a* and **205***b* formed to elastically support the first and second connection members **204***a* and **204***b* in the first and second body units **201** and **202**, respectively. With respect to the hinge unit **203**, the second elastic member **205***b* pushes the second body **202** in the first direction D**1**. Conversely, the first elastic member **205***a* provides a force pushing the first plate **201** in a direction opposite the first direction D**1** with respect to the hinge unit **203**. Accordingly, the first and second bodies **201** and **202** are forced to move in the mutually opposite directions with respect to the hinge unit **203**.

The lengths of the first and second body units **201** and **202** are substantially equal to support the flexible unit **151** in the substantially same region, but the present disclosure is not limited thereto.

Also, the flexible display unit **251** is partially fixed to the first and second body units **201** and **202** and may further include an adhesive member (not shown) to attach the flexible display unit **251** to the first and second body units **201** and **202**. Also, the flexible display unit **251** may include an unattached region S not fixed by the first and second body units **201** and **202**. Referring to FIG. **5**B, the unattached region S may be formed to cover a portion of an outer circumferential surface of the hinge unit **203** in the second state.

The first and second bodies **201** and **202** are forced to move in the mutually opposite directions by the elastic units in the first state, tensile force is provided to the unattached region S. Accordingly, the unattached region S may be maintained to be flat even though it is not supported by the body units.

Meanwhile, the first body **201** includes a first end portion **201***a* and a second end portion **201***b*, and the second body **202** includes a first end portion **202***a* and a second end portion **202***b*. The second end portion **201***b* of the first body **201** and the second end portion **202***b* of the second body **202** are formed to face each other in the first state.

The second end portions **201***b* and **202***b* of the first and second body units **201** and **202** are formed as curved surfaces corresponding to the outer circumferential surfaces of the hinge unit **203**. That is, in the second state, the second end portions **201***b* and **202***b* of the first and second body units **201** and **202** are formed to surround the outer circumferential surface of the hinge unit **203**. In other words, in the second state, the outer circumferential surface of the hinge unit **203** may be covered by the second end portions **201***b* and **202***b* of the first and second body units **201** and **202** and the unattached region S of the flexible display unit **251**.

Referring to FIG. **5**B, when the lengths of the first and second body units **201** and **202** are substantially equal, the first end portions **201***a* and **202***a* of the first and second body units **201** and **202** may be form a single end portion in the second state. That is, the first end portions **201***a* and **202***a* may be formed to be substantially flat.

In the second state, the elastic units **205** may be received in a contracted state within the first and second insertion recesses **201'** and **202'**. According to the present exemplary embodiment, the mobile terminal **200** may be forced to be changed to the first state on the basis of the elastic units **205**.

Also, since the connection units and the elastic units connecting the first and second body units **201** and **202** are partially received within the first and second body units **201** and **202**, components forming the mobile terminal **200** can be minimized, and thus, the compact mobile terminal can be provided.

FIGS. **6**A and **6**B are cross-sectional views illustrating a structure of a mobile terminal according to another exemplary embodiment of the present disclosure. FIG. **6**A is a cross-sectional view illustrating a mobile terminal in the first state according to the present exemplary embodiment, and FIG. **6**B is a cross-sectional view illustrating a mobile terminal in the second state according to the present exemplary embodiment

The mobile terminal **300** according to the present exemplary embodiment includes a flexible display unit **351**, first and second body units **301** and **302** supporting the flexible display unit **351**, a hinge unit **303** connecting the first and second body units **301** and **302** such that the first and second body units **301** and **302** are relatively rotatable with each other, and guide units **304**. The flexible display unit **351** is substantially the same as the flexible display unit **251** of FIG. **5**B, and redundant descriptions thereof will be omitted.

The first and second body units **301** and **302** of the mobile terminal **300** according to the present exemplary embodiment are connected to the hinge unit **301**. Also, the first and second body units **301** include a guide groove **304***a* having a preset length. Also, the flexible display unit **351** further includes a guide protrusion **304***b* protruding from one surface and inserted into the guide groove **304***a*. the flexible display unit **351** may include a plurality of guide protrusions **304***b*, and in order to prevent the flexible display unit **351** from being separated from the first and second body units **301** and **302**, the at least one pair of guide protrusions **304***b* may be formed to be adjacent to edges of the flexible display unit **351**.

The flexible display unit **351** according to the present exemplary embodiment may correspond to an OLED-type display unit.

The mobile terminal **300** includes a pair of third body units **306** formed on the first and second body units **301** and **302**. The third body unit **306** includes an internal space allowing an electronic component required for driving the mobile terminal **300** to be installed therein. Also, as illustrated in FIG. **6**B, the third body units **306** are formed such that one surfaces thereof are in contact with the first and second body units **301** and **302** in the second state. That is, a thickness of the third body unit **306** may be determined by a diameter of the hinge unit **303**.

In the first state, end portions of the flexible display unit **351** and end portions of the first and second body units **301** and **302** are aligned, while, in the second state, a distance is formed between the end portions of the flexible display unit **151** and the end portions of the first and second body units **301** and **302**.

A spacer **305** may be formed between the flexible display unit **351** and the first and second body units **301** and **302** where the guide unit is not formed. The spacer **305** supports

the flexible display unit **351** and the first and second body units to maintain a gap therebetween.

When the mobile terminal is deformed from the first state to the second state, the end portions of the first and second body units **301** and **302** protrude longer than the flexible display unit **351**.

According to the present exemplary embodiment, since the guide protrusion is directly formed on the flexible display unit, the structure is simplified, and even though the mobile terminal is repeatedly deformed, a problem in which the flexible display unit is separated from the body units can be minimized, and thus, durability of the mobile terminal can be enhanced.

FIGS. **7**A and **7**B are views illustrating a structure for moving or fixing the body units in the second state.

A structure for separating a pair of body units in the second state will be described with reference to FIG. **7**A. A pair of third body units **306** of the mobile terminal **300** includes a recess **307** formed as portions of facing regions of the pair of third body units **306** are recessed.

The user may put his or her finger into the recess **307** to separate the pair of third body units **306**.

A structure for fixing a pair of body units in the second state will be described with reference to FIG. **7**B. The pair of third body units of the mobile terminal **300** may include first and second magnet units **308***a* and **308***b* having different poles.

The first magnet unit **308***a* may have a protrusion shape and the second magnet unit **308***b* may have a recess shape corresponding to the first magnet unit **308***a*. The first and second magnet units **308***a* and **308***b*, having different poles, may provide a force enabling the first and second body units **301** and **302** to be maintained in the second state by attraction.

FIGS. **8**(*a*), **8**(*b*) and **8**(*c*) are a views illustrating a structure of a mobile terminal that can be deformed to a third state according to another exemplary embodiment of the present disclosure. The mobile terminal **100** implemented in the third state in which the flexible display unit **151** is bent at a preset angle (θ).

Referring to FIGS. **2**A, **8**(*a*), **8**(*b*) and **8**(*c*), the mobile terminal **100** according to the present exemplary embodiment includes a stopper module **109** installed in the hinge unit **103**. the hinge unit **103** includes a recess portion **103'** formed in a preset region, and the stopper module **109** includes a stopper **109***a* supporting the second body unit **102** and an elastic unit **109***b* received in the recess portion **103'** and elastically supporting the stopper **109***a*.

Referring to FIGS. **8**(*a*) and **8**(*b*), when the mobile terminal is changed from the first state to the third state, the stopper module **109** protrudes between the flexible display unit **151** and the first plate **102***a*. Referring to FIGS. **8**(*a*) and **8**(*b*), in the first state and the second state, the stopper **109***a* is pressed by the flexible display unit **151** and the stopper **109***a* is received in the recess portion **103'**.

While the flexible display unit **151** is being changed to the third state, a space is formed between the flexible display unit **151** and the first plate **102**, and the stopper **109***a* is projected by the elastic unit **109***b*. Meanwhile, since the stopper **109***a* supports the first plate **102***a* in the third state, a further movement of the first plate **102***b* is blocked.

In the third state, the stopper **109***b* is substantially parallel to the second plate **102***b*. Accordingly, the user may use the mobile terminal in a state in which the flexible display unit **151** is bent at the present angle (θ).

Also, since the flexible display unit **151** is prevented from being bent by the stopper module, damage to the flexible display unit **151** can be prevented.

The configuration and method of the mobile terminal according to the embodiments of the present disclosure described above are not limited in its application, but the entirety or a portion of the embodiments may be selectively combined to be configured into various modifications.

The foregoing embodiments and advantages are merely exemplary and are not to be considered as limiting the present disclosure. The present teachings can be readily applied to other types of apparatuses. This description is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. The features, structures, methods, and other characteristics of the exemplary embodiments described herein may be combined in various ways to obtain additional and/or alternative exemplary embodiments.

As the present features may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be considered broadly within its scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A mobile terminal comprising:

a flexible display configured to be deformed by changing the display from an unfolded state to a folded state;

a first body configured to support a first region of the display;

a second body configured to support a remaining region of the display; and

a hinge rotatably coupling the first body with the second body, wherein movement of the first body relative to the second body about the hinge permits the display to be changed between the unfolded state to the folded state,

wherein the second body comprises:

a first plate coupled to the hinge; and

a second plate slidably coupled to the first plate to permit the second plate to be moved in a direction that extends from the hinge to permit the display to be changed to the unfolded state and to be moved in a direction that is towards the hinge to permit the display to be changed to the folded state, and

wherein the first body is shaped to include a receiving space formed to be recessed on one side of the first body, wherein the receiving space is sized to receive the second body and the remaining region of the display when the display is in the folded state.

2. The mobile terminal of claim **1**, wherein, in the unfolded state, one end portion of the first plate and one end portion of the second plate are spaced apart from one another by a first length, and

while the display is being changed from the unfolded state to the folded state, length between the one end portion of the first plate and the one end portion of the second plate is reduced relative to the first length.

3. The mobile terminal of claim **2**, wherein when the display is changed from the unfolded state to the folded state, the first and second plates move relative to each

another such that the one end portion of the first plate and the one end portion of the second plate lie in a same plane.

4. The mobile terminal of claim **2**, wherein the first length is smaller than or equal to a half of a length of an outer circumference of the hinge.

5. The mobile terminal of claim **2**, further comprising:

a guide unit configured to guide the second plate to move in one direction while the display is changed from the unfolded state to the folded state,

wherein the guide unit comprises:

a guide groove formed on the first plate and extending in one direction; and

a guide protrusion located in the guide groove and protruding from the second plate.

6. The mobile terminal of claim **1**, wherein the first body includes a mounting space allowing at least one electronic component to be installed therein.

7. The mobile terminal of claim **6**, wherein the first body is formed to be longer than the second body, and, in the mounting space, the first body is disposed to be adjacent to the second body unit in the folded state.

8. The mobile terminal of claim **2**, further comprising:

an elastic unit configured to provide elastic force to the second plate in the folded state.

9. The mobile terminal of claim **8**, further comprising:

a side wall portion formed to surround edges of the second body and edges of the display in the folded state,

wherein the elastic unit elastically supports the side wall portion and one end portion of the first plate.

10. The mobile terminal of claim **8**, wherein one region of the elastic unit is installed in a recess formed on the second plate, and the elastic unit elastically supports the second plate and the hinge.

11. The mobile terminal of claim **2**, further comprising:

a deformation guide member attached to one surface of the display to provide an external force to enable the display to lie flat in the unfolded state.

12. The mobile terminal of claim **1**, further comprising:

connection units connecting the hinge and the first and second bodies; and

elastic units provided to elastically support the connection units and the first and second bodies.

13. The mobile terminal of claim **12**, wherein facing end portions of the first and second bodies are formed as curved surfaces to cover a portion of an outer circumferential surface of the hinge in the folded state.

14. The mobile terminal of claim **1**, wherein the display includes guide protrusions protruding from one surface of the display; and wherein

the first and second bodies include guide grooves allowing the guide protrusions to be inserted therein and extending in the one direction.

15. The mobile terminal of claim **14**, wherein a distance is formed between end portions of the first and second bodies and an end portion of the display in the folded state.

16. The mobile terminal of claim **14**, further comprising:

a pair of third bodies formed to have a thickness such that the pair of third body units are in contact with each other in the folded state, and formed on other surfaces of the first and second bodies.

17. The mobile terminal of claim **16**, wherein further comprising:

at least one recess formed on end portions of the pair of third bodies; and

magnetic units providing attraction to the pair of third bodies.

18. The mobile terminal of claim **1**, further comprising:

a stopper protruding from one region of the hinge to support the second body and to limit relative rotation of the first and second bodies beyond a certain angle.

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